Field Application of the Air Force Analytical System for Hazard Surveys (ASHS) in the Operational Environment

Juergen Hummel-Mueller
HQ USAFE/CEPP
Unit 3050, Box 10
APO AE 09094
Tel: 011-49-6371-6226
Fax: 011-49-637-432368
E-MAIL: juergen.mueller2@ramstein.af.mil

Joseph Jenus, Jr.
ASC/WMGB
102 West D Avenue, Suite 300
Eglin AFB, Florida 32542-6807
Tel: (850) 882-8787 EXT 3105
Fax: (850) 882-7983
E-MAIL: jenus@eglin.af.mil

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INTRODUCTION

The USAF Explosive Hazard Reduction (EHR) Program adapts existing technologies and develops and applies new technologies and procedures in order to implement EHR throughout the operational environment. EHR provides increased personnel and resource survivability at existing and contingency U.S. air bases and increased fighting capability of rapid reaction forces. The result is maximum sustainment of the military mission by reducing the risks associated with storing, handling, loading and transporting munitions.

The near-term thrust addresses munitions in the Air Force inventory. All munitions are considered for the potential problems they present to base survivability and the ability for the base to sustain its mission requirements. This includes fixed base as well as bare-base operations. ASHS involves an extensive munitions hazard reduction planning process that quantifies risks involved and recommends available solutions and/or required technology tasks to acquire solutions. Identified tasks are ranked based on the highest priority munitions as determined by the user. Solutions do not consider explosive changes, but do span the range from energy suppressive devices such as barriers, shielding, and packaging redesign to innovative storage and handling techniques.

The long-term thrust requires that all Air Force munitions, in research and development or product improvement programs, shall be designed to meet prevailing technical requirements of Insensitive Munitions as specified by MIL STD 2105, DoD Manual 5000-2, and the U.S. Air Force Master Plan. Operational capability must be maintained, but the goal is to meet operational requirements with the least sensitive energetic materials available for any particular weapon design.

Siting and planning for explosive ordnance handling and storage has long been recognized as a time-intensive and error-prone activity that often results in inefficient use of land and facilities. Plans for explosive operations and construction of explosive storage and handling facilities must meet Department of Defense Explosives Safety Board (DDESB) guidelines. Each year, hundreds of plans submitted for approval are rejected by the DDESB because of errors.

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Thousands more are rejected at intermediate levels for various deficiencies. The most prevalent errors involve quantity-distance standards. At the same time, a shortage of experienced site planners hampers the service. This lack of experience causes omissions, errors, and delays in the approval process and can result in inefficient siting decisions. Accurate siting is the key to logistic survivability and maximized sortie generation.

One of the major ASC/WMGB tasks is to conduct comprehensive Explosive Hazard Reduction (EHR) studies and analysis for major Air Force bases. In order to provide this capability, a baseline computerized site planning system was necessary and ASHS was developed. This baseline system was installed at Nellis AFB NV and Hill AFB UT. The results were highly successful. Explosives storage was increased in many cases and a plan to reduce waivers was identified. Hill AFB had 1000 waivers on the books. They executed the EHR plan using ASHS for re-siting and reduced the waivers to one!

COMPUTERIZED SITING SYSTEM

An explanation of the Analytical System for Hazard Surveys (ASHS) can best be presented by addressing the questions most frequently asked about the system. These questions and their answers are:

1. Q: What does the acronym ASHS mean?

A: ASHS stands for Assessment System for Hazard Surveys. It was originally created to help a team of analysts conduct explosives hazard surveys of military installations.

2. Q: What version of ASHS II is currently in use?

A: The current version as of April 10, 1998, is version 2.4 beta. ASHS has been completely redesigned starting with version 2 and is now referred to as ASHS II to distinguish it from the original Macintosh only version that is now called ASHS I.

3. Q: What kind of functionality does ASHS II provide, and who can make use of it?

A: The ASHS II software and operating procedures can be applied to support US Air Force explosives safety and civil engineering personnel. It is intended to provide assistance in maintaining compliance with applicable explosives safety rules and regulations. Given the appropriate data, ASHS II can pinpoint all of the violations of established explosives safety criteria on an entire base and provide the analytical tool to solve violation problems and increase logistic survivability. ASHS II can also automate the process of producing site plans including the AF Form 943, along with maps showing the associated IBD (Inhabited Building Distance) clear zones.

4. Q: What kind of computer system is required to run ASHS II?

A: ASHS II supports Macintosh, Windows 95, and Windows NT 4.0 operating systems. Recommended configurations are similar to current software packages: 32MB RAM, 200MB free space on a hard drive, Microsoft Word (or equivalent word processing software) to print reports, a printer, and possibly a plotter to produce large format maps.

5. Q: What kind of software is ASHS II? Is it a database, a simulation, a GIS (Geographic Information System) application, or an expert system?

A: ASHS II can seem like all of the above, but it is really a unique application that cannot be easily categorized. Like the custom stock market analysis programs used to assist traders on Wall Street, ASHS II is a vertical market application that was created to serve a very specific purpose.

6. Q: What software development systems and languages were used to create ASHS II?

A: ASHS II was created primarily using a database application development system called 4th Dimension that was originally Macintosh, but became cross-platform in 1995 when support for Windows was added. 4th Dimension (4D for short) provides a complete integrated development environment with a database schema designer, layout designer, and a full-featured scripting language that compiles to native code for each supported processor. These features, which are now widely available in development environments, have been present in 4D since 1987. 4D continues to lead in add-on modules, such as the 4D Draw package which seamlessly integrates a full-featured drawing package. 4D is a fairly unique system, but its closest competitor may be PowerBuilder. However, it would be difficult to build ASHS II using that system.

Other development tools used to create ASHS II include MPW (Macintosh Programmer's Workshop), and Delphi, both of which compile Pascal language code for the two supported platforms.

7. Q: Who owns ASHS II?

A: ASHS II was developed under contract to the US Air Force Explosives Hazard Reduction (EHR) Office by Integrated Systems Analysts, Inc. Since ASHS II includes commercial software, it cannot be said to be totally government owned; however, EHR has obtained unlimited distribution rights to runtime versions of the commercial software. Any number of copies of ASHS II may be distributed as long as they come from the EHR office.

8. Q: How is ASHS II distributed?

A: The primary distribution media for ASHS II is CD-ROM. We hope to add web site distribution in the future.

9. Q: Is there a user's manual?

A: Yes, almost 20MB of Adobe Acrobat documents are found in the Docs folder, including the user's manual.

10. Q: What kind of training and background is necessary to operate ASHS II?

A: This is a very important but difficult question to answer properly. It depends on what is meant by "operate." The key issue is the knowledge and skill needed to make coherent changes or additions to the data without destroying its integrity.

Anyone familiar with software applications running under the target operating system can quickly learn to tap the information provided in the example or pre-built databases, and even add new records, just as most people learn to use a word processor well enough to produce correspondence and simple reports. However, suppose you have used that same word processor to author a book with table of contents, index, footnotes, illustrations, tables, headers, footers, and even-odd page formats. You would be very wise to keep novice users from editing your document, because without an understanding of all of the advanced formatting and structure that you have applied to the document, they will inadvertently destroy it.

ASHS II has an even more complex and esoteric set of features than Microsoft Word owing mostly to its dependence on geographic feature data as an input to the site planning process. As a general rule-of-thumb, allow six months to become familiar with the process before you begin to depend on ASHS II for your day to day operations.

11. Q: What geographic feature data does ASHS II require and how can it be obtained?

A: To properly determine the distances and exposures between explosives and non-explosives facilities, ASHS II needs the coordinates of the exterior corners of buildings. In addition, to properly enforce the rules pertaining to certain explosives facilities (like earth covered magazines), ASHS II needs to know which corners are on the front, side, and rear of the facility. This is accomplished by ordering the points clockwise beginning with the front left corner (as you look out the door).

Existing digital maps maintained in commercial CAD systems like AutoCAD and Microstation may be converted for use with ASHS. The data must be converted to the format required by ASHS II and each facility footprint must be linked with the corresponding database record which describes the type and use of the facility from the point of view of explosives safety.

12. Q: Is digital elevation data required?

A: No, ASHS II uses a two dimensional model. For particularly hilly terrain, there is an elevation field that can be entered on each facility record. Later versions of ASHS II may be modified to incorporate this into the distance computations.

13. Q: Does ASHS II use a client-server model?

A: No, each copy of ASHS II is single-user and the database should be on a local hard drive for performance reasons. Although the database system supports this mode of operation, ASHS II does not use it, given that there has been no demand for this feature and the fact that it is an expensive add-on.

14. Q: How do we know that the answers given by ASHS II are correct? Has it been certified by someone?

A: The answers given by ASHS II depend heavily on the input data that you enter. In addition, the explosives safety criteria database used by ASHS II has not been thoroughly checked out due to the sheer size of it (36,000 records). At some point we hope to have standardized tests which can check out the calculations of ASHS II, but right now we are barely keeping up with the quarterly changes to the regulations. The current release of ASHS II is still in beta (released for general testing) stage.

Using ASHS II is like hiring someone to do your taxes: they may do the paperwork, but you are the one signing on the dotted line. In most cases, no mistakes will be made, but it pays to check the results to ensure that they make sense. ASHS II uses the Criteria Calculator to help the operator understand when it arrives at a particular answer.

15. Q: How accurate does the input data to ASHS II have to be?

A: That depends on the situation. If you are in the unique situation of having plenty of extra space, a few feet here or there, or an error or two in facility type classification will probably not be noticed. However, if you are like most people in these post-cold-war times, you are already operating at or below the minimums required for safe operations. In this case precision is required to avoid seeing problems that don't exist in the real world, or worse, not seeing problems that do exist.

16. Q: Won't ASHS II make my situation worse by pointing out problems too complex or obscure to have been noticed before?

A: Some of the problems that ASHS II finds will be minor annoyances that cause lots of paperwork to fix or waiver; however, some will be previously unknown situations that could endanger the mission. In every previous application of ASHS II we have found both types of problems. The safety and welfare of our military forces demands that we use all means at our disposal to find potential problems *before* they blow up into big ones.

EXAMPLES OF BENEFITS DERIVED FROM EHR SURVEYS/ASHS SITING

Analysis of Aviano Air Base, Italy provided an EHR implementation plan that results in:

- 93% reduction in violations (from 1923 to 104 non-critical).
- 44% increase in munitions flightline storage capability.
- Violation-free facility siting recommendation for 43 projects ($82.6M worth of construction projects).

Hill AFB, Utah

- Increased explosives storage by 10M pounds at no cost and within existing clear zones.
- Increased explosives storage (requiring some construction) to over 40M pounds with no violations.
- A plan which Hill AFB used to reduce 1000 violations to 1!
- Both bases were then provided with a computerized siting system (ASHS I) and the training necessary to operate it.

LESSONS LEARNED

The ASHS analytical system is a major technological breakthrough. When coupled with an EHR survey the results can be shocking. The first thing the bases are faced with after a survey is the number of additional violations. For example, one base had identified 365 waivers. As a result of the comprehensive ASHS/EHR study, over 1900 violations were identified. The reaction is "How could I miss all of these violations?" The answer is simple - ASHS is comprehensive, people with a straight edge and compass are not.

Other ASHS related by-products include the following factors:

- The resulting study is voluminous. It prioritizes violations from those that are most threatening to operations to those that are minor infractions. An implementation plan is provided so the user can effectively realize the total benefit of the study.
- Implementation of the study results in hundreds of additional site plans - generated by ASHS. The large number of site plans creates a major processing problem at the MAJCOM, the Air Force Safety Center (AFSC), and the DDESB. As ASHS becomes more widespread, the system for rapid and accurate handling of site plans will exacerbate this situation.

- Successful ASHS operation requires a highly trained technician to conduct comprehensive analysis. It is agreed that ASHS needs to become more user friendly, but computer literacy and siting background will always be a pre-requisite to its effective operation.

- Most important, ASHS needs to be integrated throughout the Air Force as a total system from the individual bases to the highest approval levels for munitions siting. Currently, only a small number of Air Force bases have and are using the system.

CONCLUSIONS

The ASHS system has certainly enhanced the explosive site planning capability at Hill AFB and elsewhere. Site plans are more accurate and easier to prepare; but more important, the system is an excellent management tool. Questions from the functional managers and unit weapons safety representatives can be answered quickly and accurately. The system has its most potential with large complex explosives programs. Though it is a lengthy and arduous process to set up the system, a tremendous amount of valuable information is learned about the explosives related facilities during the set up process.

Smaller explosives areas can benefit if the initial setup is accomplished by a knowledgeable explosives safety specialist. Less knowledgeable individuals can then accomplish explosives site plans if they have adequate computer training.

The best way we can explain how ASHS II works is to say, "What previously took months to do now takes minutes." It's hard to believe until you have actually seen it in action, but the days of manual calculations and drawing big circles on a map by hand are numbered. Incirlik AB is a good example of how effective the ASHS II program actually is. Using the old manual to re-site their entire base would take approximately three years; using ASHS II their weapons safety staff has been able to do it in a few weeks! However, like all good things there is a downside to the program, the weapons safety office has to get trained and work hard to get this program up and running before you can sit back and reap the benefits.